

Cosmic Ray Energetics And Mass (CREAM) launch and operation, NKU Co-I

Completed Technology Project (2016 - 2021)



Project Introduction

This is the Northern Kentucky University Co-I proposal to request continued NASA support for the on-going Cosmic Ray Energetics And Mass (CREAM) project. The balloon-borne CREAM instrument was flown for ~161 days in six flights over Antarctica, the longest known exposure for a single balloon project. Building on the success of those balloon missions, one of the two balloon payloads was successfully transformed for exposure on the International Space Station (ISS) Japanese Experiment Module Exposed Facility (JEM EF). Following completion of its system-level qualification and verification, this ISS-CREAM payload was delivered to the NASA Kennedy Space Center in August 2015 to await its launch to the ISS. The ISS-CREAM mission would achieve the primary science objectives of the Advanced Cosmic-ray Composition Experiment for the Space Station (ACCESS), which was given high priority in the 2001 NRC Decadal Study Report. Its nuclei composition data between 10^{12} and 10^{15} eV would enable detailed study of the spectral hardening first reported by the CREAM balloon project and recently confirmed for protons and helium by the PAMELA and AMS-02 space missions using permanent magnet spectrometers. In addition, multi-TeV energy electron data allow searches for local sources and the signature of darkmatter, etc. The ISS-CREAM instrument is configured with redundant and complementary particle detectors capable of precise measurements of elemental spectra for $Z = 1 - 26$ nuclei, as well as electrons. The four layers of its finely segmented Silicon Charge Detector provide charge measurements, and its ionization calorimeter provides energy measurements. Its segmented scintillator-based Top and Bottom Counting Detectors separate electrons from nuclei using shower profile differences. Its Boronated Scintillator Detector distinguishes electrons from nuclei by detecting thermal neutrons that are dominant in nuclei induced showers. An order of magnitude increase in data collecting power is possible by utilizing the ISS to reach the highest energies practical with direct measurements. The ISS-CREAM launch is currently manifested on SpaceX-12, which is scheduled for April 2017. It is expected to accumulate a total of > 4.5 years exposure during the grant period. The study of cosmic accelerators supports the Science Mission Directorate's Goal for Astrophysics in NASA's 2010 Science Plan, "Discover how the universe works, explore how the universe began and evolved, and search for Earth-like planets." It specifically addresses the Science Question, "How do matter, energy, space and time behave under the extraordinarily diverse conditions of the cosmos?"

Anticipated Benefits

The Astrophysics Research and Analysis program (APRA) supports suborbital and suborbital-class investigations, development of detectors and supporting technology, laboratory astrophysics, and limited ground based observing. Basic research proposals in these areas are solicited for investigations that are relevant to NASA's programs in astronomy and astrophysics, including the



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

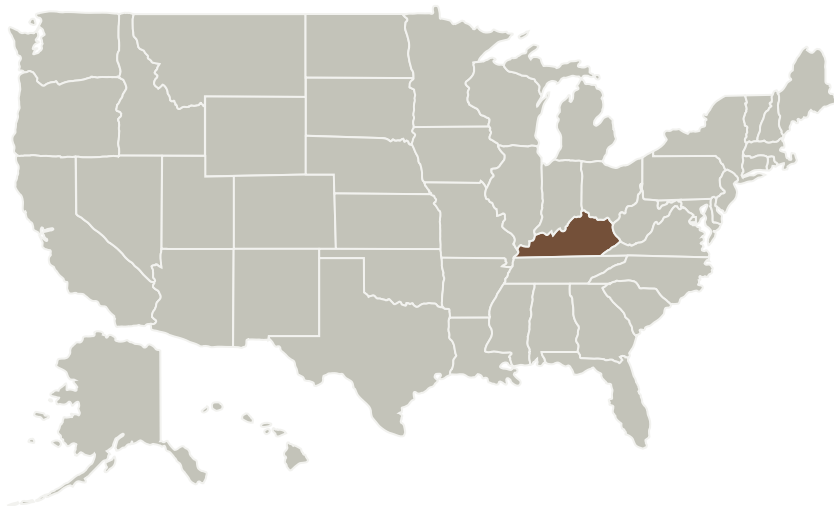
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entire range of photons, gravitational waves, and particle astrophysics. The emphasis of this solicitation is on technologies and investigations that advance NASA astrophysics missions and goals.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Northern Kentucky University Research Foundation	Supporting Organization	Academia	Kentucky

Primary U.S. Work Locations

Kentucky

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

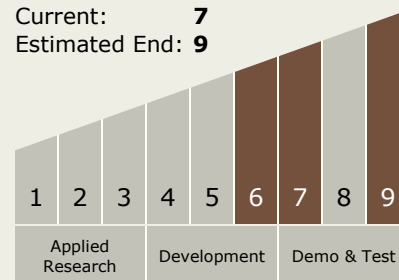
Scott Nutter

Co-Investigator:

Lisa Davis Roberts

Technology Maturity (TRL)

Start: 6
Current: 7
Estimated End: 9



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System